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IS 3436 (1978): Aluminium clad aluminium alloy sheet and strip for aircraft purposes (Alloy 24345) [MTD 7: Light Metals and their Alloys]



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IS : 3436 - 1978

Indian Standard

SPECIFICATION FOR ALUMINIUM-CLAD
ALUMINIUM ALLOY SHEET AND STRIP
FOR AIRCRAFT PURPOSES
(ALLOY 24345)

(*First Revision*)

UDC 669.715 — 41 — 408.3 : 629.13



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INDIAN STANDARDS INSTITUTION

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NEW DELHI 110002

Price Rs 5.00 **Gr 3**

January 1979

Indian Standard

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(*First Revision*)

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(*Continued on page 2*)

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Indian Standard

SPECIFICATION FOR ALUMINIUM-CLAD ALUMINIUM ALLOY SHEET AND STRIP FOR AIRCRAFT PURPOSES (ALLOY 24345)

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 25 September 1978, after the draft finalized by the Light Metals and Their Alloys Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1966 to cover the requirements of aluminium-coated Al-Cu-Mg-Si-Mn alloy sheet products, which are extensively used for fabrication of aircraft structural components. In this revision, the chemical composition and mechanical properties of the material have been modified to bring it in line with the latest developments in this field.

0.3 In the formulation of this revision due weightage has been given to International co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by deriving assistance from the following publications:

BS 3L72 : 1971 Aluminium coated sheet and strips of aluminium-copper-magnesium-silicon-manganese alloy (solution treated and aged at room temperature). British Standards Institution.

BS L107 : 1971 Aluminium coated sheet and strip of aluminium-copper-magnesium-silicon-manganese alloy (supplied for solution treatment by the user). British Standards Institution.

GOST 12592-1967 Aluminium and aluminium alloy structural sheets. Gosudarstvennyj Komitet standartov, Meri Izmeritellnyh Priborov USSR.

IGC 04.32.022-1965 (AU4G/A5) Acceptance requirements for standard size sheets. French Sud Aviation Standard.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the requirements of aluminium-clad aluminium-copper-magnesium-silicon-manganese alloy sheet, strip and coil for aeronautical applications.

2. MATERIAL

2.1 The sheet, strip and coil shall consist of a core of the alloy specified under **5.1**, clad uniformly on both sides with aluminium complying with the chemical composition specified under **5.2**.

2.1.1 Unless otherwise agreed to, the minimum average thickness of cladding on each side shall be not less than 4 percent of total sheet thickness for materials up to and including 3.0 mm thick and shall be not less than 2 percent for thicker material.

3. INSPECTION AND TESTING PROCEDURE

3.1 This standard shall be used in conjunction with IS : 3420-1976†.

4. FREEDOM FROM DEFECTS

4.1 All sheets, strips and coils shall have clean, uniform and smooth surfaces and shall be free from harmful defects, such as discolouration in patches, blisters, laminations, buckles and deep scratches. Any sheet, strip or coil may be rejected for faults in manufacture, notwithstanding its conformity to chemical composition and mechanical tests.

5. CHEMICAL COMPOSITION

5.1 The chemical composition of each cast of the alloy comprising the core of the sheet, strip and coil, when analysed in accordance with IS : 504-1963‡, shall be as given in Table 1.

*Rules for rounding off numerical values (*revised*).

†Procedure for inspection and testing of aluminium and aluminium alloys, sheet and strip for aircraft purposes (*first revision*).

‡Method of chemical analysis of aluminium and aluminium alloys (*revised*).

TABLE 1 CHEMICAL COMPOSITION OF CORE MATERIAL

(Clause 5.1)

ELEMENT	PERCENT
Copper	3.9 to 5.0
Magnesium	0.2 „ 0.8
Silicon	0.5 „ 0.9
Manganese	0.4 „ 1.2
Iron	0.5 <i>Max</i>
*Nickel	0.2 <i>Max</i>
*Zinc	0.2 <i>Max</i>
*Lead	0.05 <i>Max</i>
*Tin	0.05 <i>Max</i>
*Titanium + Zirconium	0.2 <i>Max</i>
*Chromium	0.10 <i>Max</i>
Aluminium	Remainder

*Subject to the discretion of the Inspecting Authority, determination of these elements need be made on a small proportion only of the samples analysed.

5.1.1 For the making of core material, aluminium shall comply with IS: 23-1965* and the alloying constituents, with or without approved scrap, at the discretion of the manufacturer, shall be used.

5.2 The chemical composition of the cladding material when analysed in accordance with IS : 504-1963† shall be as given in Table 2.

TABLE 2 CHEMICAL COMPOSITION OF CLADDING MATERIAL

ELEMENT	PERCENT
*Aluminium	99.5 <i>Min</i>
Copper	0.03 <i>Max</i>
Silicon	0.30 <i>Max</i>
Iron	0.40 <i>Max</i>
Zinc	0.05 <i>Max</i>
Manganese	0.03 <i>Max</i>

*To be determined by difference.

*Specification for primary (virgin) aluminium notched bars and ingots for remelting for aircraft purposes (*second revision*).

†Method of chemical analysis of aluminium and aluminium alloys (*revised*).

6. CONDITION

6.1 Sheets, strips and coils shall be supplied in one of the following four conditions:

- Type I As rolled;
- Type II Solution treated, straightened and subsequently aged at room temperature (*W*);
- Type III Solution treated, straightened and subsequently precipitation treated (*WP*); and
- Type IV As specified by the purchaser and stated on the order.

7. HEAT TREATMENT

7.1 The material shall be heat-treated as follows:

- Type II a) Solution treat by heating at a temperature of $505^{\circ} \pm 5^{\circ}\text{C}$. Quench in water at a temperature not exceeding 40°C .
b) Age at room temperature for not less than 48 hours.
- Type III a) Solution treat by heating at $505^{\circ} \pm 5^{\circ}\text{C}$. Quench in water at a temperature not exceeding 40°C .
b) Precipitation treat by heating for the requisite period (*see* Note 1) at a temperature between 160°C and 190°C .
- Type IV As specified by the purchaser and stated on the order.

NOTE 1 — The following temperatures and times have been found to be appropriate, for precipitation treatment of Type III material.

$^{\circ}\text{C}$	HOURS
165	12 to 18
175	9 „ 12
185	3 „ 6

NOTE 2 — Not more than two resolution treatments shall be carried out in any sheet/component.

NOTE 3 — Soaking time shall be as short as permissible to avoid excessive diffusion from the alloy core into the aluminium cladding. For maximum resistance to corrosion the quench delay shall be minimum and quenching water cold.

NOTE 4 — Straightening/flattening operation shall be accomplished after quenching and before ageing.

8. MECHANICAL PROPERTIES

8.1 Tensile Test — The mechanical properties obtained from test pieces selected and prepared in accordance with 8 of IS : 3420-1976* and tested in accordance with IS : 1816-1961† shall be not less than the values given in Table 3.

*Procedure for inspection and testing of aluminium and aluminium alloy sheets and strips for aircraft purposes (*first revision*).

†Method for tensile test for light metals and their alloys.

TABLE 3 TENSILE PROPERTIES

(Clause 8.1)

CONDITION	NOMINAL THICKNESS		0.2 PERCENT PROOF STRESS MPa (kgf/mm ²)	TENSILE STRENGTH MPa (kgf/mm ²)	ELONGATION ON 50 mm GAUGE LENGTH PERCENT,
			Min	Min	Min
(1)	(2)	(3)	(4)	(5)	
	Over	Up to and including			
Type I	All thickness		240 (24.5)	385 (39.5)	14
Type II	0.4 mm	0.8 mm	250 (25.5)	385 (39.5)	13
	0.8 mm	6.0 mm	250 (25.5)	390 (40.0)	14
Type III	0.4 mm	0.8 mm	350 (35.5)	415 (42.5)	7
	0.8 mm	6.0 mm	360 (36.5)	420 (43.0)	8
Type IV	As specified by the purchaser				

NOTE 1 — If the Type II material is re-heat-treated by the user, the minimum values for the 0.2 percent proof stress and tensile strength may be expected to be 15 MPa less than those specified.

NOTE 2 — $1\text{MPa} = 1\text{N/mm}^2 = 1\text{MN/m}^2 = 0.102\text{ kgf/mm}^2$.

8.2 Bend Test — Bend test shall be carried out on test-pieces, selected and prepared in accordance with 8 of IS : 3420-1976*. This test is applicable only for materials having a thickness of 2.5 mm or less. The bend test shall be carried out in accordance with IS : 4598-1968†. After bending, there shall be no evidence of splitting or cracking on the external bend surface. The angle of bend and the radius of former shall be as follows:

Condition	Angle of Bend	Radius of Former
Type I	180°	Three times the nominal thickness of the sheet and strip
Type II	180°	Three times the nominal thickness of the sheet or strip
Type III	180°	Five times the nominal thickness of the sheet or strip
Type IV	As specified by the purchaser	

9. DIMENSIONAL TOLERANCES

9.1 The dimensional tolerances for sheet, strip in coil shall be as given in IS : 3420-1976*.

*Procedure for inspection and testing of aluminium and aluminium alloy sheets and strips for aircraft purposes (*first revision*).

†Method for simple bend test for aluminium and aluminium alloy sheet and strip of thickness between 0.2 mm and 7 mm.

10. IDENTIFICATION

10.1 Each sheet, strip and coil approved by the inspector shall be stamped with the mark of the inspector and such other marking as shall ensure full identification of the material.

10.2 Unless otherwise agreed to, one side of each sheet approved by the inspector shall be marked stencilled all over at intervals of 250 mm with the specification number, type of material condition and the manufacturer's identification symbol.

10.3 One side of each coil or strip, that is not less than 50 mm wide and is not less than 0.50 mm thick, approved by the inspector shall be marked all over with the specification number, type of material, condition and the manufacturer's identification symbol.

11. CERTIFICATION

11.1 All supplies shall be accompanied by certifications for freedom from defects, chemical composition of the core alloy and the cladding material, heat treatment, mechanical properties as laid down in **5.1, 6.1, 6.2, 8.1** and **9.1**, respectively; or as required by the inspecting authority.

11.2 The manufacturer shall, when required, supply free of charge a copy of the works analysis of the material. Works analysis is defined as the routine analysis conducted by the manufacturer in order to control the quality of the material.

12. CORROSION PREVENTION

12.1 The identified sheets and coils of strips shall be coated with suitable temporary protective coating with or without interleaving non-corrosive paper (oil paper, etc) before transit or storage.

13. PACKING

13.1 Unless otherwise specified, the sheets and strips shall be oiled and packed with interleaving paper to avoid any chafing. Grease and paper shall be neutral and non-corrosive. The whole package shall be wrapped in strong waterproof paper in such a way as to avoid ingress of moisture, dust, etc, and shall be placed in a box or crate with a view to prevent any displacement of sheet metal. Gluing of sheet surfaces with neutral sticky paper in places is also permissible to prevent chafing in place of interleaving paper.

(Continued from page 2)

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INDIAN STANDARDS

ON

ALUMINIUM AND ITS ALLOYS FOR AIRCRAFT PURPOSES

IS:

- 23-1969 Primary (virgin) aluminium notched bars and ingots for remelting for aircraft purposes (*second revision*)
- 202-1966 Aluminium casting alloy ingots and castings for aircraft purposes (*second revision*)
- 2304-1962 Procedure for inspection and testing of light metals (aluminium and magnesium) and their alloy, ingots and castings for aircraft purposes
- 3420-1976 Procedure for inspection and testing of aluminium and aluminium alloys, sheet and strip (for aircraft purposes) (*first revision*)
- 3435-1968 99 Percent secondary aluminium notched bars and ingots for remelting for aircraft purposes
- 3436-1966 Aluminium clad aluminium alloy sheet, strip and coil for aircraft purposes
- 5902-1970 Aluminium and aluminium alloy rivet stock for cold forged rivets for aircraft purposes
- 7428-1974 Aluminium and aluminium alloys extruded bars, rods and sections (for aircraft purposes)
- 7429-1974 Procedure for inspection and testing of aluminium and aluminium alloy extruded bars, rods and sections (for aircraft purposes)
- 7670-1975 Aluminium alloy forging stock and forgings (for parts operated at elevated temperatures) for aircraft purposes (alloy 22588)
- 7674-1975 Procedure for inspection and testing of aluminium alloys and aluminium alloys forging stock and forgings for aircraft purposes
- 7882-1975 Aluminium alloy sheet and strip for aircraft purposes (alloy 19000)
- 7883-1975 Aluminium sheet and strip for aircraft purposes (alloy 31000)
- 7902-1975 Aluminium alloy forging stock and forgings for aircraft purposes (alloy 24345)
- 8474-1977 Procedure for inspection and testing of aluminium and aluminium alloy wires (for rivets) for aircraft purposes
- 8513-1977 Aluminium alloy wire for cold forged rivets for aircraft purposes (alloy 55000)
- 8514-1977 Aluminium alloy wire for cold forged rivets for aircraft purposes (alloy 24530)
- 8515-1977 Aluminium wire for cold forged rivets for aircraft purposes (alloy 19500)
- 8560-1977 Aluminium clad aluminium alloy sheet and strip for aircraft purposes (alloy 24530)
- 8561-1977 Aluminium alloy clad sheet and strip for aircraft purposes (alloy 76528)

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Gr 3

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Conversion
Force	newton	N	1 N = 0.101 972 kgf
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²

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AMENDMENT NO. 1 JANUARY 1983

TO

IS:3436-1978 SPECIFICATION FOR ALUMINIUM-CLAD
ALUMINIUM ALLOY SHEET AND STRIP FOR AIRCRAFT
PURPOSES (ALLOY 24345)

(First Revision)

Alterations

(Page 6, clause 6.1) - Substitute the following
for the existing clause:

'6.1 Sheets, strips and coils shall be supplied in
one of the following four conditions:

- Type I Solution treated, straightened and
subsequently aged at room temperature (W);
- Type II Solution treated, straightened and
subsequently precipitation treated (WP);
- Type III As specified by the purchaser and stated
on the order; and
- Type IV As rolled.'

(Page 6, clause 7.1):

- a) Line 2 - Substitute 'Type I' for 'Type II'.
- b) Line 6 - Substitute 'Type II' for
'Type III'.
- c) Line 11 - Substitute 'Type III' for
'Type IV'.
- d) Note 1, line 2 - Substitute 'Type II' for
'Type III'.



(Page 7, Table 3):

a) *Column 1* - Substitute the following for the existing column:

(1)

Type IV
Type I
Type II
Type III

b) *Note 1, line 1* - Substitute 'Type I' for 'Type II'.

(Page 7, clause 8.2, informal table, first column) - Substitute the following for the existing matter:

'Condition

Type IV
Type I
Type II
Type III'

(SMDC 10)